

Handout 2.2 Homework Assignment 2-1 with Answer Key:

Please use references provided in class, in combination with other sources of information you find on your own, to answer the following:

1. What is the most distinctive property of the asthenosphere?
2. Describe the process of convection in a fluid.
3. Discuss the evidence that led to the modern theory of Plate Tectonics.
4. Discuss the specific differences in the mechanisms between the plate collisions that produced the Himalayas Mountains and those that resulted in the formation of the Cascadia Subduction Zone.
5. What is the primary reason that large earthquakes are not be expected to occur on the moon?
6. Describe the three main types of interactions that occur between plates. What main type of plate interaction is associated with seismicity in California? In the Puget Sound region?
7. Is the Hayward Fault in northern California considered a plate boundary or intraplate earthquake? What about the Wasatch Fault in Utah? Explain.
8. Considering the 48 contiguous states of the U.S. (excluding Alaska and Hawaii), have the largest known earthquakes been intraplate or plate boundary events? Explain.
9. Based on the average rate of relative movement along the San Andreas Fault, how long will it take Los Angeles to become neighbors with San Francisco?
10. Considering intraplate vs. plate-boundary earthquakes in the US, which present the bigger challenge in terms of earthquake hazard preparation and mitigation?

Answers to Homework Assignment No. 2-1: Handout for instructor

1. What is the most distinctive property of the asthenosphere?

Answer: Its ability to flow, like a dense liquid.

2. Describe the process of convection in a fluid, such as that which occurs in the earth.

Answer: Hotter fluid molecules rise to the top of a heated liquid and are cooled. As they cool, they become heavier and sink back to the bottom of the liquid; a circular pattern of fluid flow is created as the hotter and cooler molecules change positions.

3. Discuss the evidence that led to the modern theory of Plate Tectonics.

Answer: A combination of findings is responsible for this theory, dating back to A. Wegener in Germany in 1912. He used fossil evidence and the similar shape of the continents on either side of the Atlantic Ocean to propose that the continents were drifting apart. Later, the fact that earthquakes tended to occur in narrow bands was key evidence. In the 1960s, magnetic evidence from the ocean floor, along with fault mechanisms that could only be explained by sea-floor spreading, confirmed the spreading of the Mid-Atlantic Ridge. Today measurement of plate movements is common due to global positioning systems, etc.

4. Discuss the specific differences in the mechanisms between the plate collisions that produced the Himalayan Mountains and those that resulted in the formation of the Cascadia Subduction Zone.

Answer: The Himalayas were formed by a continent-to-continent collision; the Cascadia Subduction zone results from a continental-oceanic collision. Continental crust is lighter than oceanic crust. Because oceanic crust is colder, denser, and heavier than continental crust, oceanic crust sinks below (subducts beneath) continental crust when the two collide.

5. What is the primary reason that large earthquakes are not expected to occur on the moon?

Answer: there are no tectonic processes occurring on the moon (i.e., the interior of the moon is not releasing heat like the earth).

6. Describe the three main types of interactions that occur between plates. What main type of plate interaction is associated with seismicity in California? In the Puget Sound region?

Answer: Three types are convergent, divergent, and transform. California is mostly transform (San Andreas Fault); Puget Sound is mostly subduction (Cascadia Subduction Zone).

7. Is the Hayward Fault in northern California considered a plate boundary or intraplate zone? What about the Wasatch Fault in Utah? Explain.

Answer: The Hayward fault is considered a plate-boundary zone, whereas the Wasatch is an intraplate fault. Although the Hayward Fault is not located precisely along the boundary where the San Andreas Fault is, the fault is very close to the boundary and is an associated fault of the San Andreas. In other words, a large fault zone such as the San Andreas Fault zone can consist of many small regional faults, all considered more or less a part of the overall plate boundary. The Wasatch Fault is too far inland from the edge of the continent to be considered a plate boundary fault.

8. Considering the 48 contiguous states of the US (excluding Alaska and Hawaii), have the largest known earthquakes been intraplate or plate boundary events? Explain.

Answer: Largest have been the magnitude 8+ earthquakes in New Madrid (1811-12). This is an intraplate region.

9. Based on the average rate of relative movement along the San Andreas Fault, how long will it take Los Angeles to become neighbors with San Francisco?

Answer: Relative movement of the plates is about 3 cm/year, or about one foot in 10 years, or about one mile in 52,800 years. Since LA and San Francisco are about 400 miles apart, this process would take about 20,000,000 years.

10. Considering intraplate vs. plate-boundary earthquakes in the US, which present the bigger challenge in terms of earthquake hazard preparation and mitigation?

Answer: This is arguable. The plate-boundary events are more likely, but better understood. Because the intraplate earthquakes are poorly understood, the true risk is rarely known as well for these events. Therefore, the appropriate level of hazard preparation is less clear than for plate-boundary regions where the risk is more clearly established and better recognized by all.